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Carbon literacy

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A 'by chance' conversation just over two years ago introduced BASF to the concept of Carbon Literacy training and set us on a journey of stakeholder engagement on climate change. We knew then that a problem exists (the climate crisis), that we as an organisation played our part in it and that we had a strategy aimed at overcoming it. But a challenge remained: how to engage our colleagues and stakeholders in something abstract and remote. Carbon Literacy appeared to be the mechanism by which we could bridge that engagement gap.

BASF does not 'own' Carbon Literacy but has partnered with the Carbon Literacy Project to help with that journey. In fact, the Carbon Literacy Project itself would probably say it also do not 'own' Carbon Literacy but merely enables the conditions through which decent quality climate change education can be delivered. A not-for-profit group, The Carbon Literacy Project was set up in Manchester around ten years ago as a result of the local authority looking to engage its citizens in their climate change agenda. And it is appropriate that the world's first industrial city is the one leading the change.

So, what does the Carbon Literacy Project do? Well, what they don't do is directly deliver climate change education. Rather, they provide the framework and support that allows others to do this. They set the quality standard against which courses are checked and accredited, which subsequently enables participants to become certified as Carbon Literate. The accreditation and the quality standard are vital to its success, as poor climate change education is as bad as having no climate change education.

An Accredited Carbon Literacy course must have some key structural elements. It needs to be the equivalent of one full day of learning, delivered locally and by peers and involves elements of self-discovery and group enquiry. However, organisations are expected to customise the course to reflect their own context, making the training more relevant to those participating. This means that the training course delivered by BASF will be different to that of Siemens, Patagonia, the BBC or the Environment Agency yet an observer would be able to recognise all of those courses as Carbon Literacy. Training outcomes are action focussed. Each participant must make two action pledges, one to reduce their personal carbon footprint and one to work with others to reduce their organisation's carbon footprint.

It is about equipping people with enough information to make more informed decisions allowing them to make choices that reduce their carbon impact. We are all creatures of habit and giving people the understanding to change those habitual behaviours for less impactful ones is what the course seeks to achieve. In my experience, course participants want to do something to help but are confused by conflicting information. The course helps them understand the key issues and sets them in the right direction.

But why are we doing it? Because we want to save the planet. We also have a responsibility as a sector due to our contribution to the problem. The chemical industry itself creates 5.6% of all greenhouse gas emissions, 3.6% being from the sector's energy use and 2.2% being direct emissions from our manufacturing processes. BASF itself has a carbon footprint of 21m t of CO_2e annually. The size of our contribution is quite staggering, yet we also must recognise that many of the products produced by the sector have a part to play in saving CO_2 when used by our customers and our customer's customers.

BASF's corporate purpose is 'We create chemistry for a sustainable future'. We are doing a lot to reduce our own carbon footprint to achieve the net zero pathways laid out in the Paris Climate Agreement. Much of what we are doing is focused on reducing emissions from our largest emitting processes, which is driving innovation in these technologies. As an example, BASF has committed to re-engineering our steam crackers to run on electricity, which if run on renewable energy has the potential to reduce the greenhouse gas emissions of the sector by millions of tonnes (*C&I*, 2021, **85**, 4, 7). A real game changer for upstream organic chemistry, with implications for all the products that flow from it.

As well as addressing the big-ticket items, we can also encourage individual action. In creating Carbon Literate employees, we give them a level of understanding that enables them to engage better with the overarching principles of our company. And small actions across large populations add up to significant impacts. If we can get every BASF employee to commit to saving 2 t of CO_2 each, that would be nearly a quarter of a million tonnes saved. Now imagine if this could be replicated across all 16m employees in the chemical sector.

As the world's largest chemical company, we believe in leading the way on this. We are currently in discussion with The Carbon Literacy project to develop a sector specific toolkit that will allow other companies in the industry to deliver the programme, moving a step closer to this vision. One of the cornerstones of Carbon Literacy is positivity and I believe that the climate emergency is solvable. But, as highlighted by Barack Obama: 'We may be the last generation who can do something about it'. The time for action is now, before that opportunity slips away.

Focus on PFAS

Ian Ross, *Technical Director and Global PFAS Practice Lead, Tetra Tech*

A major challenge for industry, regulators and environmental professionals is reacting appropriately to emerging contaminants. This is especially relevant for per- and polyfluoroalkyl substances (PFAS), a broad group of some several thousand synthetic fluorochemicals, which are the focus of dramatically increasing regulatory action.

PFAS are present in firefighting foams used to protect against flammable liquid fires, and many other products such as inks, paints, waxes, hydraulic fluids, paper and textile coatings. The ongoing use and manufacture of products containing multiple PFAS is under significant scrutiny, with the concept of essential use being proposed for future regulation.

Regulatory concerns are fuelled by the identification of an increasing number of PFAS-impacted drinking water supplies, with 6m Americans reported to be affected in 2016. Numerous health conditions including high cholesterol, ulcerative colitis, thyroid disease, testicular cancer, kidney cancer, and pregnancy-induced hypertension have been associated with certain PFAS.

Meanwhile, more and more lawsuits are being filed against polluters by communities and businesses impacted by PFAS contamination.

Extremely conservative, parts per trillion (ng/L) targets in drinking water have been established in many parts of the world for two PFAS – perfluorooctane sulphonate (PFOS) and perfluorooctanoic acid (PFOA). In 2016, the US the Environmental Protection Agency (EPA) published a long-term health advisory of 70ng/L for PFOS and PFOA in drinking water. In the UK, revised levels of 100 ng/l for PFOS or PFOA were published earlier in 2021 by the Drinking Water Inspectorate, with the need to consult health professionals if levels exceed 10ng/L. There are also exceptionally low criteria for PFOS in surfaces waters in the UK set at 0.65ng/L.

However, in many countries the regulatory attention on PFAS has broadened beyond these two PFAS to include polyfluoroalkyl substances such as fluorotelomers, C4/C6 (short chain) PFAS and perfluoroalkyl ethers such as GenX.

Many more proprietary PFASs are present in commercial products than are regulated. These polyfluorinated varieties have evaded detection by common analytical methods. Firefighting foams, for example, comprise hundreds of individual PFAS that could not be measured until the recent development of a more comprehensive assessment using the total oxidisable precursor (TOP) assay. In the environment, these polyfluorinated PFASs will all eventually transform to create perfluoroalkyl PFAS, which persist indefinitely, so regulators in Australia have recently adopted this analytical method for sampling environmental matrices and compliance.

In Europe and the UK, regulations commencing in July 2021 stipulate that holding over 50kg of PFAS-containing firefighting foams can represent a notifiable stockpile of persistent organic pollutants (POPs). The nature and volume of foam held is required to be reported to the Environment Agency annually. Establishing the nature of each foam and whether it exceeds the criteria that determine whether it represents a notifiable stockpile requires chemical analysis of PFAS present in products using the TOP assay.

When firefighting foams are replaced in suppression systems, a significant mass of PFAS adhering to interior surfaces of these systems require decontamination, with water being ineffective. So, replacement foams become impacted with g/L concentrations of PFAS. When considering disposal of PFAS-laden firefighting foams, there are increasing concerns that incineration does not destroy PFASs, with litigation progressing in the US.

Given the proposed restrictions on all PFAS-containing foams in Europe, their continued use seems likely to incur significant environmental liabilities for the end user, so switching to F3 foams is a wise decision. The extinguishment performance of these F3 foams has been proven in multiple tests since 2002.

Tetra Tech has significant expertise applying and interpreting data from the TOP assay, has specialist cleaning agents to remove PFAS from the interior of fire suppression system and is working with suppliers of equipment to destroy PFAS in multiple waste types. We have formulated a team of environmental and fire engineers to provide a series of services which deliver foam transition as a package.

When considering a portfolio of sites, a risk ranking sites approach to establish the environmental sensitivity of each site can be useful to determine their potential to impact drinking or surface waters. This can help with prioritising foam changeouts and determining the likelihood of receptors being impacted by PFAS.

Although the business risks PFAS pose can appear complex and initially seem difficult to manage, chemical companies can seek the help of experienced teams to help them proactively tackle potential issues and establish a plan to manage the increasingly regulatory attention to PFAS.

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Jonathan Abell,
Managing Director of Scientific Services, Search Consultancy

Plugging the skills gap

Although an increasing number of women are enrolling at university, just 30% of the world's researchers are women. Our research at Search Consultancy reinforces this, with 52% of managers admitting the industry lacks gender diversity.

Despite more people choosing to study STEM subjects at university, the scientific industry is still suffering from a significant skills shortage. Search Consultancy's 2021 *Skills Shortage Report* shows 74% of organisations within the sector are currently feeling the strain, with a shortfall of around 173,000 skilled STEM workers. On average, this leaves business understaffed by 17%.

The situation has been exacerbated in the past year with Covid-19 increasing the demand for experts. Combined with rising import costs due to Brexit, this skills gap could significantly hinder the UK's progress within the scientific industry. This has created a perfect storm, with new STEM roles expected to double in the next 10 years.

To resolve the skills shortage in the industry, we need to address the problems. A lack of diversity is a key contributing factor and the gender divide in science is well documented, with women making up just over 24% of the UK's STEM workforce. Although an increasing number of women are enrolling at university, just 30% of the world's researchers are women. Our research reinforces this, with 52% of managers admitting the industry lacks gender diversity. This is partly due to STEM stereotypes with many school-aged children believing the industry is better suited to males.

This is reinforced by low-quality careers advice and a lack of school funding in STEM subjects. The lack of diversity in the industry also extends to race and age – with 65% and 46% of managers, respectively, saying they believe the sector struggles.

Our research also highlights three additional key contributing factors impacting the skills shortage in the scientific industry. Of those surveyed, 55% say that a simple lack of qualified candidates is a cause for concern. This raises the question: is there a lack of skilled workers, or are the skills and qualifications they possess, mismatched to the job required?

Further to this, 38% of those surveyed cite a lack of training opportunities as a cause for the skills shortage in their organisation. When it comes to training, many employers are reluctant to invest as it can often be costly and does not provide the short-term relief required. Businesses also face the risk of training employees, only to lose them to competitors. A further 28% say job cuts within the business and Brexit are also contributing factors.

The skills gap is having serious implications on businesses and their employees in the scientific industry. Some 58% of managers say teams have to work longer hours, with 28% of organisations missing deadlines, losing business and having a disengaged workforce.

Due to the nature of the industry, employers within the sector are understandably risk-averse when it comes to recruiting and skillsets are incredibly specific. If a candidate does not possess all the required skills for a particular role, many organisations would rather not hire at all.

This, in turn, has severe consequences on the industry with the skills gap costing the science industry £1.5bn/year. However, the impact stretches further than purely financial. A recent UK Government report shows that the number of STEM graduates within an organisation strongly correlates with innovation within the business. As an increasing number of science-based businesses establish themselves within the UK, the nation needs to remain a key player despite growing import costs. To do so, we must prioritise innovation.

We now need to look to the future and establish how, as an industry, we resolve the issue. Whilst the number of people studying STEM subjects at university has increased by 16%, compared with ten years ago, the supply is yet to meet the required demand.

It is evident that Brexit, increased university fees and Covid-19 will further widen the gap. Therefore, significant investment is needed in STEM subjects to encourage young people to pursue a career in the sector. Organisations that can, may want to invest in apprenticeships and scholarship schemes to encourage young people to consider a career in the sector. Working closely with schools and colleges to explain the benefits of pursuing a career in science will also help bridge the gap.

Internally, structured employee training and development schemes need to be executed to promote professional development. This allows businesses to fill the specific skills they are lacking, widening the remit of the talent they already have available.

It is crucial that we un-bury our heads from the sand and address the skills issue head-on. Only then will the UK see the innovation required to remain globally competitive.